

PREPAREDNESS AND RESPONSE PLAN OF TOP-10 FRAGILE STATES IN CONTAINING COVID-19

SUMMER INTERNSHIP

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PART-1:

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I perceive this opportunity as a big milestone in my professional development. I will strive for the best possible use of the skills and recognition gained and will continue to work on their improvement to achieve the desired career path.

Sincerely,

(Dibyaloson Rabha)

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ABBREVIATIONS

CAST: Conflict Assessment Tool

CERP- Contingent Emergency Response Implementation Plan

FFP-Funds For Peace

FSI- Fragile State Index

IEC-Information, Education Communication

IOM- International Organization for Migration

IPC-Infection Prevention Control

MoE-Ministry of Education

RCCE-Risk Communication and Community Engagement

UNICEF- United Nations Childrens Emergency Fund

UNOCHA-United Nations Office for Coordination in Humanitarian Affairs

WHO-World Health Organization

Chapter-1

INTRODUCTION

According to the report of Funds For Peace 2018 “The Fragile State Index(FSI) is an annual ranking of 178 countries based on their different levels of pressures they face that impact their levels of fragility. The index is based on the Funds for Peace proprietary Conflict Assessment Tool (CAST) analytical approach.”

These levels of pressures are assessed with the help of CAST developed by Funds for Peace (an independent, non-partisan, non-profit, research and educational and research organization). The comprehensive social science methodology has three primary streams of data “ quantitative, qualitative and expert validation” and these are triangulated and subjected to critical review in order to obtain the final score. The FSI score should be interpreted with the understanding that, lower the score the better it is.

While the entire world is fighting against the pandemic, these fragile states are fighting with various other problems. The kind of problems they are facing pose a much more bigger challenge to fight against the pandemic. Threats on the safety of the states which include terrorist attacks, bombings and deaths due to battle in the countries such as Syria became part of their life. According to the Situation report that was published on 17th April 2020 by OCHA, Sudan holds 1.1M refugees and 1.87M IDPs. Even if the government advises to follow social distancing norms, to put them into practice in these areas is a herculean task. In these highly populated areas, extra efforts need to be emphasized in containing the pandemic.

The conflict between the government and Sudan People’s Liberation Army-North caused the country to struggle with chronic health needs related to underdevelopment, poverty and political instability. Being the newest nation formed in July 2011, the country poses difficulty in developmental challenge. The number of health facilities which are functional are 1147 and is believed to be serving 10.5M population and the number includes just 37 hospitals. More than half the population live in more than 3 mile far from the nearest Primary Health Centre. There are 1.5 doctors and 2 nurses for every 100000 citizens.

On 6th April 2020 The World Bank activated Contingent Emergency Response Implementation Plan(CERP) under Provision of Essential Health Services Project to support coordination and planning with surveillance and rapid response teams in DRC. Besides these, the plan will also include teams of professionals who cover case investigation, case management, laboratory testing, risk communication, community engagement and social mobilization, and infection prevention and control

Due to security threats, it is even a greater challenge to recruit health workers to work in these areas. This adds one more challenge to handle the pandemic. Due to weak governance, poverty and political instability, Congo’s response plan to Covid-19 is aggravated. The disease outbreak of Ebola puts an additional aggravating conditions for the country. However, the health ministry along with other agencies implemented The DRC COVID-19 Strategic and Response Plan Project funded by International Development association to fight the pandemic.

The situation report of Zimbabwe published by OCHA, shows that more than 43,000 people remain displaced in camps and host countries. These people needed shelter support which the government provided a technical support as a response. But it has been observed that there is an urgent need to upgrade the shelter supports in terms of adequate hygiene facilities and handwashing stations amid the pandemic. People were not provided with adequate

information on Covid-19 and measures of prevention. There were two isolation facilities identified which was not fully equipped.

Of the 10 countries, I was able to get only Somalia who established incident management system, the second step of the first pillar of WHO's preparedness and Response Plan. The Federal Government of Somalia initiated Risk communication strategies to involve the community as the active participants in containing the pandemic. Somalia does not have the capacity to test Covid-19. UNICEF supported the Risk Communication and Community Engagement of Somalia distributing over 320 IEC materials, 162 public addresses were made through sound trucks, 27 mosque announcements and conducted 196 community leader's orientations. Around 189,238 people were reached through house to house visits.

This study aims to assess the various preparedness and response plan of top 10 fragile states as categorized by Funds For Peace. Although WHO has recommended the "8 pillars of Preparedness and Response Plan" in containing Covid-19, it is due to shortage of available data from authentic sources, I have restricted the assessment only to the available data.

The table below is preliminary country categorization by WHO based "on additional information of voluntary external evaluation, pandemic influenza preparedness plans, country readiness assessment for health emergencies, missions to the countries, as well as the most up-to-date country specific COVID-19 situation analyses."

Table No.1 Preparedness and response status for countries: Country's Preparedness Capacity

Level-3	Level-2	Level-1
Democratic Republic of the Congo	Chad	Central African Republic
Sudan	Somalia	
Zimbabwe	Yemen	
	Afghanistan	
	South Sudan	

(Syria was not included)

RATIONALE

OCHA situation report no. 13 published on 1st May 2020 says that 846000 people in Syria remain in displacement out of which 60% are children and 21% are estimated to be women. The most urgent need for these displaced people are food, water, shelter and proper sanitations. There is also a burden of malnutrition in the country. The country's economy puts an additional burden to these displaced people with consistent increase in prices of the food and other basic needs. When the country is already fighting against many other problems unlike other countries, it becomes a big challenge to fight against the pandemic.

In Zimbabwe 7M people are in urgent need of humanitarian assistance, and the country is currently facing malarial and other communicable disease outbreak and drought conditions that trigger several other health risks. There is a possibility of movement of the refugees from one village to another and if infected with covid-19 will create havoc among the people. The need to share SOPs in these camps is of top priority. Poor sanitation and drinking water have increased the risk of communicable diseases.

South Sudan holds 24 ICU beds with 4 ventilators. Somalia holds 100 quarantine beds with 46 ventilators. Zimbabwe has 2 isolation facilities which are not fully equipped. It was estimated that there is requirement of 129 ventilators with a gap of 108 in Zimbabwe. In Afghanistan the capacity of laboratories is 50 tests per day having only one lab. However, they planned to increase test capacities. Somalia does not have testing facility that becomes a challenge for early detection of cases. The health system of Somalia is already fragile and it also holds 260,000 migrants crossing across 7 borders and 2.6Million displaced people.

WHO provided two different guidelines for Risk Communication and Community Engagement readiness and response plans. One for the countries with no cases and the other for with confirmed cases. However, the countries that I have chosen are already countries with confirmed cases, therefore, I am excluding the assessment of the countries with no cases.

In the era of Information Technology people are bombarded with various information. Many a times people become unaware of the fact that these information are actually misleading them. Infodemics is the term used for the excessive information that becomes difficult to identify the solution. Proper risk communication intervention could help them gain accurate and relevant information and can prevent infodemics

Health workers along with the community leaders should be well informed about the current situations so that the people follow the necessary steps to be followed. It is when the community is engaged the country can fight against the pandemic.

Chapter-2

LITERATURE REVIEW

The armed groups, intra and inter-ethnic/communal violent conflicts, epidemics, natural disasters and food insecurity are various problems faced by Democratic Republic of Congo . 8.4 million people lack access to WASH services and 8.4 million vulnerable persons lack protection. It is also found that there are 5 million internally displaced persons and 2.1 million returnees are registered. (Situation Report No.05, 10th April-17th April 2020)

“UNICEF distributed infection prevention and control supplies to 3 Provincial Health Departments and 20 health facilities, and 4 hand washing kits to be placed in public sites. UNICEF also launched the local production of 66,000 masks, trained 209 people (health manager, health provider and community agents) on infection and prevention control in the context of COVID-19.” (Situation Report No.05, 10th April-17th April 2020)

In Afghanistan, the community learning centres were requested to remain closed. This affected the education of 7.5million children in regular schools and 5,00,000 children. In a country with 3.7 million children already out of schools could result in permanent drop outs. However, Ministry of Education initiated an alternative delivery mechanism to reach the students through television and radio. The initiative facilitated self-learning. UNICEF supported the MoE to develop and implement guidelines for safe school operations and the need for WASH facilities in Community Based Education Centres.(UNICEF Afghanistan, 13th April 2020)

In Sudan, WHO trained 50 laboratory staffs on sample collection, transportation and testing. National Public Health Laboratory in Khartoum, Sudan processes the COVID-19 tests. It has the capacity of 30 tests per day. It is planning to increase the capacity up to 600 tests per day. PPEs have were distributed to the laboratory staff by WHO. As a part of emergency response team IOM established handwashing stations in Khartoum.(IOM, Sudan Situation Report, 17th April, 2020)

The Government and partners developed The National Contingency Plan of Chad for Preparedness and Response to the pandemic which was supported by UNICEF. The UN developed a UN Joint Covid-19 Operational Support Plan that is helping in capacity building of health workers, sanitation, 14 healthcare providers were trained in detection, referral and appropriate management of Covid-19. Various challenges faced by the country are the laboratory capacity, lack of infrastructure and sanitations at quarantine sites and limited supply of PPEs for health care workers. (Situation Report No. 1 Chad, UNICEF, 1-15th April)

The Ministry of Education of Somalia is developing online contents for distance learning for students. It also used TV and Radio as their learning platforms.

Project details

METHODOLOGY-

Study area- South Sudan, Somalia, Yemen, Syria, Central African Republic, Democratic Republic of Congo, Sudan, Chad, Afghanistan and Zimbabwe

Study Type – Qualitative study

Study design – Descriptive, analytic, cross-sectional study

Study period – 60 days

Data Collection –Secondary data is collected from the situation reports published by UNICEF, UNOCHA and WHO

Chapter-4

Results /Findings

Table no. 2 Assessment of Country Level Coordination, Planning and Monitoring

SI No.	Name of the country	Activate multi-sectoral, multi-partner coordination mechanisms to support preparedness and response	Engage with national authorities and key partners	Conduct initial capacity assessment and risk analysis, including mapping of vulnerable populations
1	South Sudan	Yes	Yes	Not mentioned
2	Somalia	Yes	yes	Not mentioned
3	Yemen	Yes	Yes	Not mentioned
4	Syria	Yes	Yes	Not mentioned
5	CAR	Yes	Yes	Not mentioned
6	DRC	Yes	Yes	Yes
7	Sudan	Yes	Yes	Not mentioned
8	Chad	Yes	yes	Not mentioned
9	Afghanistan	Yes	Yes	Yes
10	Zimbabwe	Yes	Yes	Yes

Assessment of Risk Communication and Community Engagement

Table No. 3 Number of people reached through various platforms with information on Covid-19

SI No.	Name of the country	No. of people reached
1	South Sudan	3.4M
2	Somalia	6M people targeted to reach
3	Yemen	16M estimated
4	Syria	17.4M
5	CAR	2M
6	DRC	10M
7	Sudan	31M
8	Chad	Not specified
9	Afghanistan	472000
10	Zimbabwe	Data not available

*The following table shows the number of people reached through various platforms on Covid-19 risk communications:
(Note: these data is might not remain the same)*

Table No. 4 Various spokespersons involved to deliver risk communication messages

Sl No.	Name of the country	Religious leaders and opinion leaders	Community leaders/ Community workers
1	South Sudan	×	×
2	Somalia	×	×
3	Yemen	√	×
4	Syria	×	√
5	CAR	×	√
6	DRC	×	√
7	Sudan	×	√
8	Chad	√	×
9	Afghanistan	×	×
10	Zimbabwe	×	×

Table No.5 Use of TV and Radio as modes of communication.

Sl No.	Name of the country	TV/Radio
1	South Sudan	Not mentioned
2	Somalia	√
3	Yemen	Not mentioned
4	Syria	√
5	CAR	√
6	DRC	√
7	Sudan	√
8	Chad	√
9	Afghanistan	√
10	Zimbabwe	Not mentioned

Table No. 6 Special platforms used by the countries for risk communication

Sl No.	Name of the country	Special platforms
1	South Sudan	Megaphones
2	Somalia	×
3	Yemen	discussion programs and live phone-in programs
4	Syria	Smart Card/Takamol application and online/ interactive quizzes
5	CAR	×
6	DRC	U-report platform quiz platform
7	Sudan	Megaphones
8	Chad	U-report platform
9	Afghanistan	×
10	Zimbabwe	×

Assessment of IPC

Table No.7 Availability of Supplies and services, PPE to health staff and staff training

Country	WASH/IPC		
	Supplies and services	PPE to health staff	Staff training
South Sudan	√	×	√
Somalia	√	√	√
Yemen	√	√	√
Syria	√	√	√
Central African republic	-	-	-
Congo Democratic Republic	√	√	√
Sudan	√	√	√
Chad	√	√	√
Afghanistan			
Zimbabwe	√	√	√

Assessment of Education Systems

Table No.8 Distance learning and safe school protocols

Country	Education	
	Distance learning initiative	Safe school protocols
South Sudan	×	×
Somalia	√	√
Yemen	√	√
Syria	√	√
Central African republic	-	-
Congo Democratic Republic	√	×
Sudan	×	×
Chad	√	√
Afghanistan		
Zimbabwe	√	√

Assessment of Laboratory Capacity

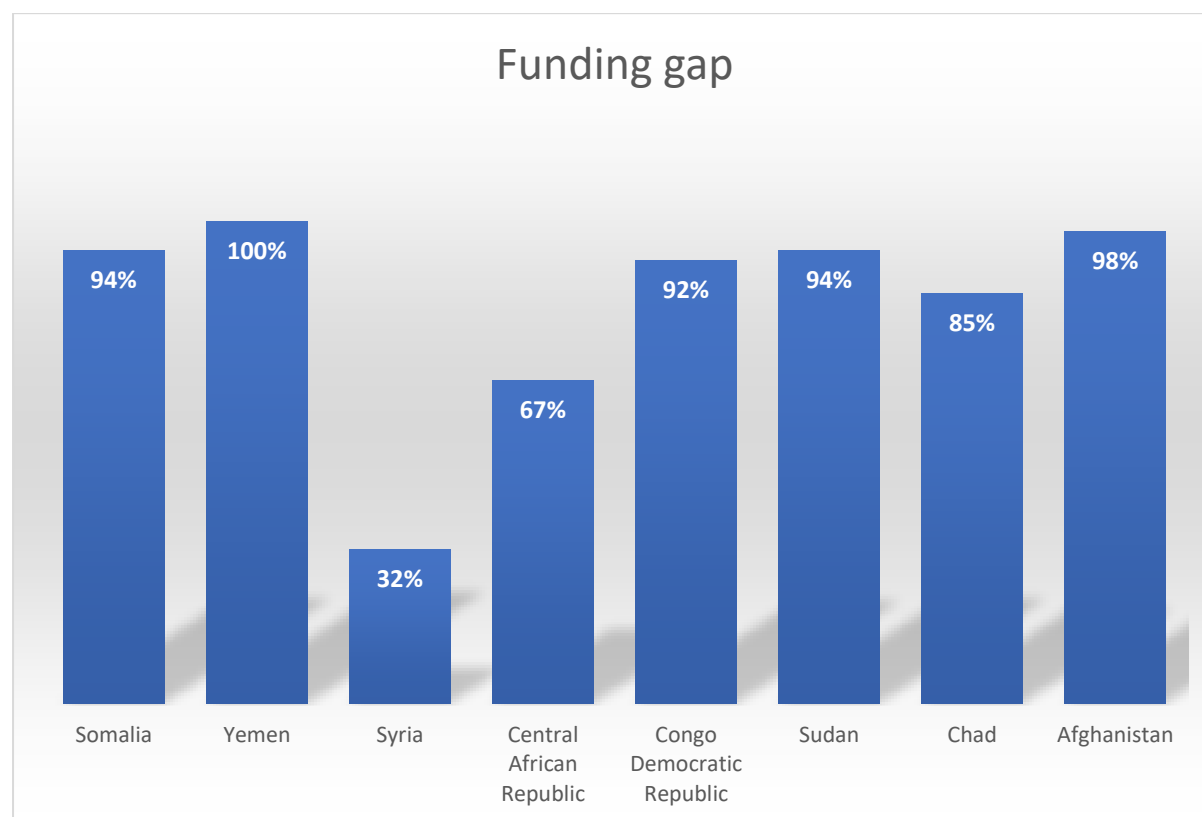
Table No.9 No. of tests done per 1M population

SI No.	Name of the country	Total cases per 1M population	Total tests	Total tests per 1M population
1	South Sudan	143	3356	300
2	Somalia	147	-	-
3	Yemen	16	120	4
4	Syria	8	-	-
5	Central African Republic	339	15881	3292
6	Congo Democratic Republic	-	-	-
7	Sudan	139	401	9
8	Chad	51	-	-
9	Afghanistan	538	48305	1243
10	Zimbabwe	19	52905	3563

(Data as on 8/6/2020, Source: www.worldometers.info)

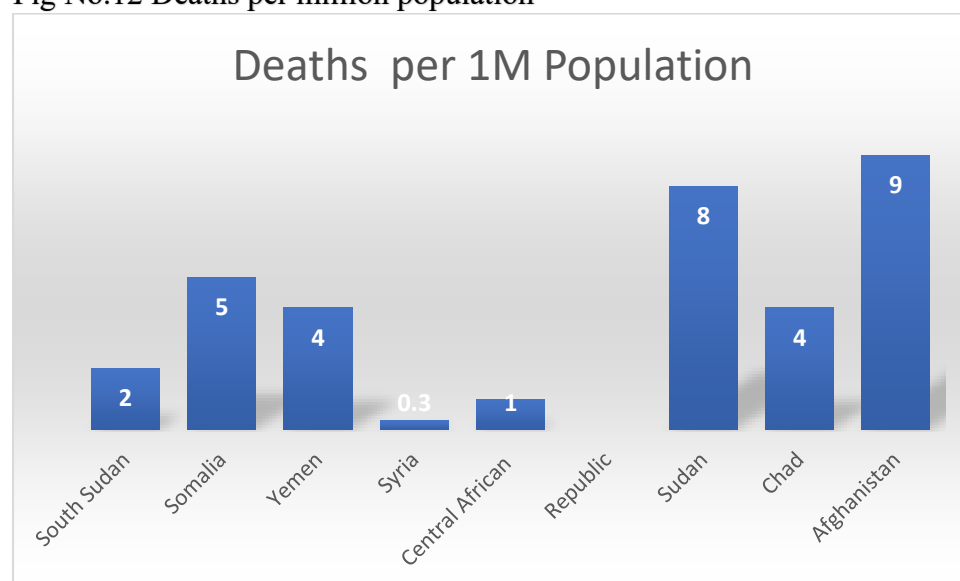
Assessment of Funding gaps

Table No.1 Gaps in the Estimated budgets



(Note: South Sudan and Zimbabwe were excluded due to non-availability of data)

Fig No.12 Deaths per million population



(note: No data were available for DRC)

(Data as on 8/6/2020, Source: www.worldometers.info)

Chapter-5

Conclusion / Summary

From the above tables, it is seen that Syria has the least percentage of funding gaps and least number of cases per million population. 17.4M population were reached on the information about the preventive measures of the virus. The country also used a special platform for risk communication. Therefore, proper funding gap and risk communication is necessary to fight against this pandemic.

It is also quite evident from the above tables that the countries with high funding gap are having higher number of death per million population. The reason could be due to unavailability of resources for the treatment. Since a lot of funds are required for the procurement of resources, these countries were not able to meet those requirements.

All the 10 countries have activated the multi-sectoral, multi-partnership engagement in response to the pandemic. DRC, Afghanistan and Zimbabwe conducted the risk assessment and mapping of the vulnerable populations. However, the other countries might have also done it but, from the sources there was no mention of the said conditions.

South Sudan, CAR and Afghanistan are doing poor in terms of risk communication. Only a few percentage of the population has been reached with the information on the safety measures against the virus. Proper precautionary measures on WASH and hand hygiene and social distancing has not been covered properly by these countries. Yemen and Syria covered a higher percentage of population on risk communication messages through various platforms.

South Sudan, Somalia, Afghanistan and Zimbabwe did not include the local spokespersons and other influential leaders. It was only the government who acted as the spokespersons. These local leaders can communicate more clearly with the community and deliver messages. Yemen and Chad have involved the religious leaders. These leaders delivered messages in the mosques and other religious places. Syria, CAR, DRC and Sudan involved the community leaders and community workers.

In South Sudan, Yemen and Zimbabwe due to unavailability of data I would not say that they did not use radio/television and other modes of mass communications. The rest of the countries have used radio and television that can cover a large number of population at a time.

DRC and Chad were the only two countries that use the U-report platform. Somalia, Afghanistan and Zimbabwe have not used any special platforms for the risk communication. Megaphones, discussion programs and live-in programs smart card/Takamol applications were different platforms used by different countries to send messages about the virus.

South Sudan did not include PPE to the health staff. The health staff are at the higher risk in contracting the virus. This poses a greater challenge for the country in containing the virus.

The rest of the country has included supplies and services and training to the health staff. They are doing well in terms of WASH/IPC.

Both South Sudan and Sudan, did not take into account to the education system amid the pandemic. All the other countries took initiative in distance learning for the school going children. They also have used the safety school protocols for the students. The educations for most of the school going children got affected due to the lockdown imposed by the governments in these countries. In spite of that they found out an initiative of distance learning. It could be due to the lack of technology in South Sudan and Sudan they did not include the distance learning for the students.

Zimbabwe is doing great when in terms of laboratory capacity. Afghanistan and CAR also at its best when seeing the number of cases and the number of tests done. It shows that they have enough laboratory capacity to do the tests. There was no data available for DRC.

UNICEF, UNOCHA and other agencies have estimated the required budget for different activities. It is in accordance to their estimated budget required and the budget received from various organizations they have published the report of the funding gaps. Yemen requires the entire funds of the budget. It is seen that the country did not receive any funds. Except Syria the rest of the countries need high funding support so that they can take proper steps in containing the pandemic.

The countries such as Yemen and Syria were able to cover a huge number of population with risk communication and are having comparatively with a lower number of cases. However, Afghanistan covered only 472000 people and as per the data shows the highest number of cases. Therefore, we can conclude that proper risk communication and community engagement is one of the major factor in containing the pandemic.

Chapter-6

Recommendations/Suggestions

- Afghanistan should focus more on RCCE as their number of cases will get worse.
- There is a need to increase the number of isolation beds and should be equipped with basic equipment.
- The countries need to increase partnerships for more funding as they have high funding requirements.

ANNEXURE:1

Region/Country	RCCE			WASH/IPC			Health			Education, Social Protection, Child Protection, & GBV							
	People reach	People engage	People interact	Supplies and services	PPE to health staff	Staff training (IPC)	Training detect and refer	Essential Services	Breast feeding	SAM treatment	Distance learning	Safe school protocols	Alternate care	Mental health support	Training GBV and refer	Abuse & exploit. report	Cash grants
ESAR																	
Angola	●	●	○	●	●	●	●	○	○	●	●	○	●	○	○	○	●
Botswana	●	●	●	○	●	○	○	○	○	○	●	●	●	●	○	○	●
Burundi	●	●	●	●	●	●	○	●	●	●	●	●	●	●	○	○	○
Comoros	●	●	●	●	●	●	●	●	●	●	●	●	○	●	○	●	●
Eritrea	●	●	●	●	●	●	●	●	○	○	○	○	○	●	○	○	●
Eswatini	●	●	●	●	○	●	●	●	●	○	○	●	○	○	○	○	●
Ethiopia	●	●	○	●	●	●	○	○	●	●	●	●	●	●	○	○	○
Kenya	●	○	●	●	●	○	○	○	●	●	●	○	○	●	○	○	●
Lesotho	●	●	○	●	●	○	○	○	●	○	●	○	○	●	○	○	●
Madagascar	●	●	●	●	●	●	●	●	●	●	○	○	○	○	○	●	●
Malawi	●	●	●	●	○	●	●	○	●	●	○	○	○	●	○	○	○
Namibia	●	●	●	●	●	●	●	●	○	●	●	●	○	○	●	●	●
Republic of Mozambique	●	●	●	●	○	●	●	○	●	●	●	○	●	●	●	○	●
Rwanda	●	●	○	○	●	●	●	○	●	○	●	●	○	○	○	○	○
Somalia	●	○	○	●	○	○	○	○	○	○	●	○	○	●	○	○	○
South Africa	●	●	●	○	○	○	○	○	○	○	○	○	○	○	○	○	○
South Sudan	●	●	○	●	○	●	○	○	○	●	○	○	○	○	○	○	○
Uganda	●	●	●	●	○	○	○	○	○	○	○	○	○	○	○	○	○
United Rep. of Tanzania	○	○	○	●	○	●	○	○	○	○	○	○	○	○	○	○	○
Zambia	●	●	●	●	●	●	●	●	●	○	○	○	○	○	○	○	○
Zimbabwe	●	●	●	●	●	●	●	●	●	●	○	○	○	○	○	○	○

Table 1: COVID-19 Preparedness and Response Status for Countries, Territories, and Areas,² as of 6 March 2020

Response Category	Country Preparedness Capacity				
	Level 5		Level 4		Level 3
5- Community transmission	China				
4- >=10 cases	Australia	Norway	Algeria	Oman	India
	Belgium	Republic of Korea	Austria	San Marion	Lebanon
	Canada	Singapore	Bahrain	Thailand	
	Denmark	Spain	France	Viet Nam	
	Germany	Sweden	Iran (Islamic Republic of)		
	Iceland	Switzerland	Kuwait		
	Israel	United Arab Emirates			
	Italy	United Kingdom of Great Britain and Northern Ireland			
	Japan	United States of America			
	Malaysia				
	Netherlands				
3- <10 cases	Finland	Monaco	Andorra	Latvia	Argentina
	Lithuania	New Zealand	Brazil	Luxembourg	Armenia
		Portugal	Chile	Mexico	Morocco
		Slovenia	Croatia	Poland	Azerbaijan
			Czechia	Romania	Nepal
			Egypt	Russian Federation	Nigeria
			Estonia	Saudi Arabia	North Macedonia
			Greece		Philippines
			Ireland		Qatar
					Senegal
					Ukraine

Funding Status

Sector	Funding requirements	Funds available	Funding gap \$	Gap %
Communication & Hygiene	1,098,800	280,000	818,800	75%
WASH	1,938,283	674,631	1,263,652	65%
Nutrition	1,955,381	546,530	1,443,976	74%
Health & HIV/AIDS	1,600,336	450,000	1,150,336	72%
Child Protection	1,208,400	189,825	1,018,575	84%
Education	1,098,800	70,000	479,400	87%
Cash-based Transfers	- (*)	- (*)	- (*)	- (*)
Total	8,900,000	2,175,861	6,724,139	76%

* Amount to be confirmed (based on the ongoing socio-economic impact assessment and vulnerable household targeting strategy for emergency assistance)

Pillar 1: Country-level coordination, planning, and monitoring

National public health emergency management mechanisms should be activated with engagement of relevant ministries such as health, education, travel and tourism, public works, environment, social protection, and agriculture, to provide coordinated management of COVID-19 preparedness and response. NAPHS and PIPPs, if available, should also be adapted to address COVID-19.

Step	Actions to be taken
1	☐ Activate multi-sectoral, multi-partner coordination mechanisms to support preparedness and response
	☐ Engage with national authorities and key partners to develop a country-specific operational plan with estimated resource requirements for COVID-19 preparedness and response, or preferably adapt, where available, an existing <i>Influenza Pandemic Preparedness Plan</i>
	☐ Conduct initial capacity assessment and risk analysis, including mapping of vulnerable populations
	☐ Begin establishing metrics and monitoring and evaluation systems to assess the effectiveness and impact of planned measures

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PART-2

Report on Online course:

Name of the course:-

Epidemiology: The Basic Science of Public Health
Course provider: “Coursera.org”

TABLE OF CONTENTS:

WEEK-1

- Definition
- History of epidemiology
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- Pioneers of epidemiology
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- Experimental study designs

WEEK-4

- Measures of association
- Confidence interval

WEEK-5

- Introduction to causality
- Bradford Hill Criteria

Learning methodology used in the course:

Videos, quizzes and reading materials from various published papers and journals.

Key Learnings from the course

WEEK-1

Definition :

“Epidemiology is the study of the distribution of health outcomes or disease within the populations and the factors that determine the spread of the health outcome and the disease”.

The field of disease began when people started looking for a rational explanation of diseases rather than assuming that diseases are caused by evil spirits. In addition, the empirical observations and other causes of mortality. Initially the field of epidemiology focused on infectious diseases but was totally altered with the advent of information technology.

History of epidemiology:

- ⇒ **1950-** focus was on the infectious diseases and the specific conditions that are associated with them.
- ⇒ **1960-** focus was on the laws of the spread of the diseases at the community level.
- ⇒ **1980-** focus was in controlling and minimizing the health problems and the diseases.

Epidemiological transitions:

Describes the changing patterns of populations, age distributions, mortality, fertility, life-expectancy and causes of death.

First transition was related to infectious diseases and the diseases that are associated with nutrition. 10,000 years ago people learnt to produce food and but they had no knowledge about the nutrition that are available in different food items. This caused nutritional deficiencies among the people. They even learnt how to domesticate animals for food. This resulted in increased zoonotic diseases. The agricultural activities increased their contact with disease causing vectors.

Second transition was where the body's immune system and disease causing organisms both started to evolve. This changed the disease epidemics to endemic. Due to physical and genetic changes the effects of the disease got minimized.

In Third transition the disease pattern changed from infectious diseases to chronic and degenerative diseases due to improved nutrition, better public health and clinical medicine. People started to have more sedentary lifestyles in this era which caused more Cardiovascular diseases and cancer among people.

The fourth transition started in 20th century where globalization started. During this time both the new disease as well as the infectious diseases occurred. The infectious disease re-emerged and there was rapid spread of this infectious diseases.

Pioneers of epidemiology:

1. *Hippocrates*-A Greek physician who thought about rational explanation about disease rather than supernatural explanations. Hippocrates described the periodicity of the malarial parasite and the malarial paroxysm.
2. *Girolamo Fracastoro*(an Italian Physician) described that the disease can be transmitted through “contact, air and contaminated clothing.” In 1546, he presented his writing on “contagion and contagious diseases and proposed that diseases were caused by rapidly multiplying seeds.”
3. *John Graunt* was the first demographer who contributed to epidemiology. During the time of plague he calculated survivorship on a chart in London. His statistical and census methods became the basis of modern demography. In 1662, he published his observations made upon the bills of mortality which was the first statistically based analyzes.
4. *James Lind* was a Scottish physician who took interest in the cause and treatment of scurvy. His theory was that citrus fruits could cure scurvy. Vitamins were not known during that time. In 1700, it was suspected that the sailors who died during circumnavigation of the world, had scurvy. For this, a total of 12 men were chosen and these people were grouped into six pairs. All the six pairs received the same basic diet. He gave each pair a different supplement. One group received a quarter of cider. 25 drops of elixir of vitriol or sulphuric acid was given to the second group, 6 spoonful of vinegar to the third group, half a pint of sea water to the fourth group, two oranges and two lemons to the fifth group and to the last group a spicy paste was given. One sailor in the group was able to work. His work led to the need for improved nutrition and modern day clinical trials began.
5. *Percivall Pott* was the first person who showed the relationship between environmental carcinogen and cancer. He was an English surgeon. He noticed that the scrotal skin sores can be seen more in workers working in chimney sweeps. Non-infectious disease epidemiology began after Pott’s work.
6. *William Farr* took statistical data and tested social hypothesis. He demonstrated the “relationship between population density and mortality rates. He also mapped deaths, monitored outbreaks and developed a system to categorize the causes of death.” The mortality death data system that he developed was “an antecedent to the international classification of disease system that is used today.”
7. *Edwin Chadwick* studied about the issues with sanitation in the United Kingdom. He supported the idea about “the association between the disease conditions and the people’s living conditions and there was a strong need for both public and social reform.”
8. *John Snow* known as the Father of modern epidemiology was the first person to investigate the outbreak in London in 1854. Snow showed the increased in cholera symptoms who lived and worked in one district. The rate of illness were higher in the people who were using Broadway street pump than the other areas of London.

Examples of Research areas using epidemiology

1. Infectious disease epidemiology
2. Chronic disease epidemiology
3. Maternal and child health epidemiology
4. Environmental epidemiology
5. Nutritional epidemiology
6. Health behavior epidemiology

Definitions of epidemiology:

There are many definitions of epidemiology. In the mid 19th century the word epidemiology was first used to describe the scientific study of epidemics. But for the given course epidemiology was defined as “the study of the distribution and determinants of disease or health outcomes in specified populations and the applications of this study to the control of health problems”. The present day epidemiology covers the study of all varieties of illnesses, health outcomes and injury as they affect populations.

“Epidemiology is used to develop, target and evaluate program strategies.”

There are three levels of public health preventions. They are:

1. *Primary prevention*: It is the prevention done before the occurrence of the disease or health outcome. It may reduce the prevalence, risk or rate of a health outcome. E.g. vaccination.
2. *Secondary prevention*: It is done after the occurrence of a disease but before the symptoms are noticed by the person. The main aim of the secondary prevention is to find and treat the disease. E.g. checking skin growths so as to detect skin cancer and treat as early as possible.
3. *Tertiary prevention*: It happens after the person has already contracted the disease and with the symptoms. Tertiary prevention aims to prevent further damage and reduce pain from the disease. It even aims to slow down the progression of the disease, prevent any kind of complications that may occur and to help people to recover early with proper care. E.g. asking people to follow proper dietary advice such as sugar-free diet to manage diabetes.

Epidemiology is used in evaluations of Public health interventions which occurs at two levels:

- Individual intervention is focused on changing individual risk behaviors. It relies on their individual decisions with the assumptions that people have capacity to make choices and follow the choices they made. E.g. “education on the health benefits of quitting smoking.”
- Structural intervention is focused on the improvement of public health. This intervention changes the physical, social or economic factors in the environment. E.g. providing clean drinking water in the community.

Public health is all about prevention of illnesses and disability and to increase life expectancy. It also promotes physical and mental health efficiency. Public health also deals with the community efforts for environmental sanitation, disease preventions, educating the individuals about the risk factors and so on.

Descriptive vs Analytic epidemiology

Descriptive epidemiology refers to the characteristics of persons such as *age, sex, race and socio-economic status*.

Characteristics of place are *country, province, state, zip code or census track*.

Characteristics of time such as long term *trends* or short term *by week or days*.

“Descriptive epidemiology simply refers to the distribution of the pattern of disease or health outcome in a population.”

“Analytic epidemiology aims to study research and risk factors and preventive factors of the disease.”

We use analytic epidemiology when we are trying to find out the underlying cause of the pattern of the disease and investigate the cause.

Mainly focuses on the search for cause and effect, or with *why and where* questions.

Two perspective of health and disease:

1. Biomedical perspective
2. Population perspective

The *biomedical perspective* focuses on specific biological factors such as agents that cause diseases.

Population perspective focuses on “social, psychological and environmental factors that are associated with the health outcome.”

With population perspective we look into two factors as:

- Proximal or downstream factors are micro level factors and include “physiological and biological factors such as genetic make-up, age, ethnicity, gender and immune status.”
- Distal or upstream factors are macro level factors such as “global forces and government policies.”

The major determinants that may be addressed upstream are community design, education, employment, living, working conditions of the people and poverty. Population perspective refers various causes or factors that play a role in development of a disease.

WEEK-2

Measures of disease frequency

Prevalence

- Prevalent cases are existing cases of a disease.
- Prevalence is a *proportion*.
- Prevalence help us quantify the proportion of population with a specific health outcome.

The two types of prevalence measures are:

- Point prevalence measures prevalence at one point in time.
- Period prevalence measures prevalence over a specified period of time.

Risk

- Risk measures the new and the incident cases of the health outcome that is developed among the people in a population at risk over a specified time period.
- Risk is used in decision making of drug intervention.
- “In a closed study population, people in the study cannot leave or enter the population due to *birth, death, migration or loss to follow up*.”
- Numerator of risk is incident cases and denominator is the study population at risk.

Rates

- Rate is not a proportion because it does not have a fixed *denominator*.
- Can be used for a *dynamic population*.
- Risk population change *due to birth, death or migration*
- People in a study can decide to leave the study in a midway.
- Rate accounts the person-time which is the sum of time.
- *Study of repeated events can be done*.
- Rate is more costly and data collection is challenging.

Odds

- It is the ratio of probability that the disease will occur to the probability the disease will not occur.
- Odds are easy to calculate and interpret.

WEEK-3

EXPERIMENTAL STUDY DESIGNS

Randomized control trials:

- Randomization gives the strongest evidence for causal inference.
- Randomization is done by chance and helps to reduce biases.
- RCTs is very costly
- They have issues with *external validity and generalizability*.
- There are ethical concerns in conducting RCTs.

Clinical crossover

- Switching of subjects from one treatment to another after a period of time is called clinical crossover.

Blinding: technique used to hide certain information from the people that are involved in the study.

There are four types of blinding categories:

- A **non-blinded study** is where no information is hidden, therefore, everyone knows about who received the intervention.
- A **single-blinded study** where information is concealed to one category of person. It could be either the subject, researcher, or statistical analyst,
- A **double-blinded** study where blinding is done to both the tester/researcher and the subjects.
- A **triple-blinded** study where everyone is blinded that include the subject, the researcher as well as the statistical analyst.

Equipoise: refers to “the genuine uncertainty about the benefits or harms of the possible treatment or exposure.”

Placebo: are sham treatment. These are similar to the actual treatment but the active interventional agent is absent.

“Compliance and adherence refers to whether or not the participants follow the treatment, medications or recommendations as some participants may not stick with their assigned treatment or exposure.”

“Intention to treat: refers to when the subjects are analyzed according to their randomized treatment regardless of whether they actually got or took the treatment.”

“Experimental study designs are gold standard for inferring causality”

Observational designs

- Case-control
- Cohort
- Ecological
- Cross-sectional

Case control study design:

Case control studies are efficient and the most common study design used to study rare diseases. *Cases* are the diseased individuals or individuals with the health outcome that we are interested in. *Controls* are the individuals without the diseases. Case-control proceeds from effect to outcome.

The three most important steps to conduct a case control study are:

1. *Defining and selecting the cases.*
2. *Defining and selecting the controls.*
3. *Measurement and comparison of the prevalence of exposure in the controls versus cases.*

Since the denominator is the at risk population and it is not ascertained, we use odds ratio as the measure.

Uses of case control study:

1. In rare outcome.
2. When the exposure data is expensive to obtain.
3. Diseases with long induction and latent period
4. If there is less information available about the disease.

Cohort Study design:

In cohort study, researchers follow the population at risk over a period of time and evaluate the exposure and finds out the risk or rate of disease or health outcome. *A cohort is a group of persons sharing a common characteristics.* Epidemiologist may define their cohort with multiple shared factors. Some examples of common characteristics are gender, geographic location, occupation socio-economic status, age or race.

A cohort study can be done for rare exposure because it is not convenient to identify and assemble group of persons who have an uncommon exposure. E.g. a study for the hazardous substances. A cohort study was set up in the US Air Force veterans who got exposed to a very rare substance called the Orange Agent which was used in the Vietnam War in order to study the effects of the substance. This was not possible to conduct in a general population since it was a rare substance. Rate or risk is used in Cohort study design. Cohort does not depend on outcome of interest at the outset. Cohort study can be: *Open or closed.*

In an *open cohort*, participants can join the study at any point in time, from starting to the end but within the limitations. It collects person time therefor there are no issues with the sample sizes.

In a *closed cohort study design*, “the cohort is formed at the beginning of the study.”

There are two types of cohort study:

1) *Retrospective cohort study*: It goes from outcome to exposure. It is often used to evaluate occupation related exposures such as cancer and other diseases in the people who work in factories and get exposed to hazardous chemicals. This study needs subject’s history to identify the important baseline characteristics otherwise not possible to conduct.

2)*Prospective cohort study*: It starts exposure to outcome. The investigator obtain the baseline characteristics of the exposure and follow the cohort to measure the health outcome of interest after the exposure.

Advantages of cohort study:

1. Allows direct estimation of risk or rates.
2. Ability to assess rare exposure.
3. Multiple outcomes can be assessed from a single study.

Disadvantages:

1. It is expensive to conduct.
2. Time consuming.

Ecological

In ecologic study exposure and health outcome data are collected at a group level. Group level data averages the exposure of the group and not individual. In this study we know only know the health outcome of the group and not individuals. *Ecological fallacy* is the biggest limitation of this study. It concludes that the association between the exposure and health outcome is true for both, at a group level as well as in the individual level also. It is very much clear that this might not be true. Group level data are available in census data, mortality and cancer registry. It has low cost and more convenient. It is useful in evaluating interventions which are at community level. One disadvantage of ecological study is that it is hard to substantiate that exposure preceded outcome.

Cross sectional

Exposure and outcome are assessed at the same point in time within the specific study population. In cross sectional study we include all the prevalent cases in the numerator while in the denominator we include both the prevalent and non-cases.

Steps to conduct a cross sectional study:

1. Define a study population.
2. Ascertain the prevalence proportion of the health outcome in the study population.

Uses of cross-sectional study:

1. Used to estimate the occurrence of risk factors or health outcomes in the population.
2. is important in the decennial census.
3. Opinion polls or political polls.
4. Surveillance of long lasting diseases.
5. Surveillance in changes in smoking habits or other behavioral risk factors.

WEEK-4

Measures of association

“The measures of association tells us about the strength of association between the exposure and the health outcome.”

The different measures of association include:

1. Risk ratio
2. Rate ratio
3. Odds ratio
4. Prevalence ratio

The incident or new cases are used by risk ratio and rate ratio, but prevalence ratio use prevalent cases. The denominators for each differ. Risk ratio has the population at risk study in the denominator while rate ratio use the person time at risk. In Prevalence ratio, the denominator is the entire study population. And in the Odds ratio the non-cases comes in the denominator. "The ratio measures indicate the relative strength of association between the exposure and a disease or health outcome compared with the absence of exposure or less exposure."

Odds Ratio

Odds ratio is calculated in a case-control study.

"It is probability of event occurring divided by the probability of the event not occurring."

Interpretation:

When odds ratio =1, there is no association.

When odds ratio >1, there is positive association.

When odds ratio <1, there is negative association.

Confidence Interval

Confidence interval gives us the idea about the variability or uncertainty in a given range, in either of the measure of association or measure of disease occurrence. They are statistical construct that provide us with the true value that lies within a certain degree of probability. It also provides information about the direction and strength of the effect. We calculate the estimated value due to the unavailability of the exact value.

If an experiment is performed 100 times, an estimated risk ratio is calculated each time and in the 95% confidence interval it is expected that the true value of the risk ratio will contain 95 out of 100 times. The most common confidence interval that is used is 95%. However sometimes 90% or 99% confidence interval is used. While interpreting a 95% CI we should keep in mind, 95% CI does not mean that the true value will lie within that range.

P-value:

It tells the probability that "whether the study results are consistent with being due to chance."

WEEK-5

INTRODUCTION TO CAUSALITY

Definition of causality given by Rothman and Greenland in American Journal of Public Health 2005- "an event, condition or characteristics that preceded the outcome or disease event and without which the event either would have not occurred at all or would have not occurred until some later time." Causality is not observed but often inferred and is known as causal inference. Determining the causal relationship provide an epidemiologist the targets for prevention and intervention, such as insecticide nets to prevent malaria. Even if the exposure precedes a health outcome, it does not always mean causality. E.g. Carrying a lighter precedes lung cancer, but if you ask "is carrying a lighter causes lung cancer?" the answer is "No".

It is thus important to differentiate between causal association and spurious association. Causal association is when the occurrence of a disease event depends upon the occurrence of one or more events. The event will not occur without occurrence of the other event. When we

see the smoking and lung cancer, it can be very well explained that without the lighter smoking will not occur. When there is a spurious association, it means that biases, failure to control for extraneous variables such as when there is confounding misapplied statistics, or models etc. have played a role.

Bradford Hill Criteria

Sir Austin Bradford Hill, an epidemiologist and statistician identified nine factors that determine causality. It is said that Hill's Criteria is not a checklist for causality but should only be used as a guideline.

The first criterion is "*strength of association*" between the exposure and outcome of interest. The strength of association is measured via risk ratios, rate ratios and odds ratios.

"Strong associations occur when exposure is a strong risk factor and there are other risk factors for the disease."

He showed the risk factor for lung cancer is smoking.

"*Consistency*" refers to the situation where the study results of various populations and situations can be reproduced. However, if there is no consistency, the causal association should not be ruled out, because some of the results are generated under specific combinations of causal components. These conditions might have not been met under that conditions.

"The greater the consistency the more likely is a causal association."

"*Specificity of association*" is when one risk factor is related consistently to a single effect, then it is likely to be play the causal role. For example, Tuberculosis and Mycobacterium Tuberculi has a direct one-to-one relationship. But this criterion remains invalid in smoking and lung cancer association because lung cancer is caused due to myriad of causes and not solely on smoking.

"*Temporality*" is the weakest guideline among all.

"For an exposure to be causal its presence must precede the development of the outcome." We can rule out causality, if temporality is absent. It was always shown that "pulmonary embolism caused atrial fibrillation." However the most recent studies showed that it could be also be true in the reverse order. The only criteria that is necessary for causality is Temporality.

The "*Biological gradient*" criterion is dose depended. It suggests that higher the dose higher is the risk of diseases. The dose response gives evidence for the causal relationship. However, we should not rule out the causal relationship if the dose response is absent. Some needs a threshold exposure for the causal relationship to occur. For example there is a gradient of lung cancer by current amount smoked. Smoking won't cause lung cancer until a threshold amount of smoke is reached. In some occasions the laboratory experimental evidence helps to draw conclusion with better confidence, but it is always not necessary.

"*Coherence*" is providing evidence against causality. In coherence there should not be any new data that could oppose the evidence.

To explain it better, the course provided with an example "smoking causes inflammation of the respiratory tract, release of free radicals, conversion of cells to pre-neoplastic states, transformation of cultured cells to cancer, activation of oncogenes and lung cancer in humans. The coherence guideline is more demanding than mere biological plausibility in that the evidence here must be extensive, cutting across disciplinary lines, all of which mutually support causal association between exposure and health outcome."

"*Experimental evidences*" are the outcomes which are collected from various areas such as laboratory, epidemiologic studies, preventive and clinical trials. A well-controlled study such

as randomized control trial is required for an experimental evidence. For example the sun exposure can be controlled so that we can study the effects of skin cancer and the individuals can be randomized according to the level of exposures i.e. high and low exposure and potential changes can be examined.

“Analogy is when a factor is suspected of causing an effect.” We should also consider the other factors which are similar or analogous to the suspected cause. It should either be considered as a possible cause or otherwise should be eliminated from the study. Analogy is speculative in nature as it depends on the subjective opinion of the observer and is a weaker criteria. “Absence of analogy should not be taken as evidence against causation.”

The above guidelines should be used only for the body of knowledge and not merely applied to one or two studies. Among all the guidelines, temporality is one guideline that is necessary. However, the absence of any one or the other criteria does not rule out the causality. There are other criteria for causality such as Causal Pis, Counterfactual models and Directed Acyclic Graphs.